(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 083 117 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
10.04.2024 Bulletin 2024/15

(21) Application number: **14821291.3**

(22) Date of filing: **27.11.2014**

(51) International Patent Classification (IPC):
B23C 3/30 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B23D 61/025; B23C 3/30; B23C 5/08;
B23B 2251/56; B23C 2210/56; B23C 2220/40

(86) International application number:
PCT/IL2014/051031

(87) International publication number:
WO 2015/092784 (25.06.2015 Gazette 2015/25)

(54) ROTARY CUTTING TOOL HAVING A DISK-SHAPED CUTTER BODY PROVIDED WITH SUPPORT PADS

ROTATIONSSCHNEIDWERKZEUG MIT EINEM SCHEIBENFÖRMIGEN SCHNEIDKÖRPER MIT STÜTZPOLSTERN

OUTIL DE COUPE ROTATIF AYANT UN CORPS DE DISPOSITIF DE COUPE EN FORME DE DISQUE POURVU DE TAMPONS DE SUPPORT

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **19.12.2013 US 201314135164**

(43) Date of publication of application:
26.10.2016 Bulletin 2016/43

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a disk-shaped rotary cutting tool and a cutter body assembly having a plurality of support pads, for use in metal cutting processes in general, and for slotting and slitting operations in particular.

BACKGROUND OF THE INVENTION

[0002] Within the field of rotary cutting tools having a plurality of support pads, devices are known in which the support pads are arranged about the peripheral surface of a cutter body and configured to contact a workpiece in a radial direction, in order to stabilize and center the cutting tool. Support pads may also be referred to as "wear pads", "bearing pads", or "guide pads".

[0003] US 2010/0158623 discloses such a rotary cutting tool.

[0004] Within the field of rotary cutting tools used in slotting and slitting operations, devices are known in which a plurality of cutting inserts are arranged about the peripheral surface of a cutter body, and each cutting insert is configured to cut one of the two parallel slot surfaces.

[0005] US 2011/0097164 discloses such a rotary cutting tool.

[0006] Such rotary cutting tools may produce inaccurate slot widths due to axial cutting forces acting on the cutting tool.

[0007] It is an object of the present invention to provide an improved rotary cutting tool and cutter body assembly which overcomes the above-mentioned disadvantages.

[0008] It is also an object of the present invention to provide an improved rotary cutting tool and cutter body assembly having a plurality of support pads.

[0009] It is a further object of the present invention for the improved rotary cutting tool and cutter body assembly to have a plurality of indexable support pads.

[0010] It is yet a further an object of the present invention for the plurality of indexable support pads to be axially adjustable.

[0011] It is still a further object of the present invention for the axial adjustment of the plurality of support pads to be performed accurately and reliably.

[0012] JP S58 102615 A discloses a face milling cutter. The preamble of independent claims 1, 4 and 7 is drafted in view of this reference.

SUMMARY OF THE INVENTION

[0013] In accordance with the present invention, there is provided a cutter body assembly comprising the features defined in claim 1.

[0014] Also in accordance with the present invention, there is provided a support pad removably retainable in a disk-shaped cutter body, comprising the features defined in claim 4.

[0015] Further in accordance with the present invention, there is provided a cutting tool comprising the features defined in claim 7.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] For a better understanding, the invention will now be described, by way of example only, with reference to the accompanying drawings in which chain-dash lines represent cut-off boundaries for partial views of a member and in which:

Fig. 1 is an exploded perspective view of a cutter body assembly in accordance with a first embodiment of the present invention;

Fig. 2 is a partial side view of the cutter body assembly shown in Fig. 1;

Fig. 3 is a partial end view of the cutter body assembly shown in Fig. 1;

Fig. 4 is a partial cross-sectional view of the cutter body assembly shown in Fig. 2 taken along the line IV-IV, with axial projections of the associated support pads;

Fig. 5 is a cross-sectional view of the cutter body assembly shown in Fig. 3 taken along the line V-V, showing the associated support pad in a side view;

Fig. 6 is the cross-sectional view shown in Fig. 5, with the associated support pad removed;

Fig. 7 is an exploded perspective view of a cutter body assembly in accordance with a second embodiment of the present invention;

Fig. 8 is a partial side view of the cutter body assembly shown in Fig. 7;

Fig. 9 is a partial end view of the cutter body assembly shown in Fig. 7;

Fig. 10 is a partial cross-sectional view of the cutter body assembly shown in Fig. 8 taken along the line X-X, with axial projections of the associated support pads;

Fig. 11 is a cross-sectional view of the cutter body assembly shown in Fig. 9 taken along the line XI-XI, showing the associated support pad in a side view;

Fig. 12 is the cross-sectional view shown in Fig. 11, with the associated support pad removed;

Fig. 13 is a perspective view of a cutting tool in accordance with some embodiments of the present invention;

Fig. 14 is a side view of the cutting tool shown in Fig. 13, engaging a workpiece;

Fig. 15 is a detailed view of the cutting tool shown in Fig. 14;

Fig. 16 is a partial end view of the cutting tool shown in Fig. 13;

Fig. 17 is a cross-sectional view of the cutting tool shown in Fig. 16 taken along the line XVII-XVII, and

Fig. 18 is partial cross-sectional view of the cutting

tool shown in Fig. 17 taken along the line XVIII-XVIII, with axial projections of the associated support pads.

DETAILED DESCRIPTION OF THE INVENTION

[0017] Attention is first drawn to Figs. 1 to 3, and 7 to 9, showing a cutter body assembly **20**, **20**' including a cutter body **22** and a plurality of support pads **24, 24'** removably retained therein.

[0018] The cutter body **22** has an axis of rotation **R,** two opposing end surfaces **26a, 26b** and a body peripheral surface **28** extending therebetween.

[0019] As shown in Figs. 2 and 8, a median plane **M** perpendicular to the axis of rotation **R** intersects the body peripheral surface **28.**

[0020] Each of the plurality of support pads **24, 24'** may protrude from one of the two opposing end surfaces **26a, 26b.**

[0021] Also, in some embodiments of the present invention, the median plane **M** may intersect the body peripheral surface **28** along its entire circumference.

[0022] As shown in Figs. 1, 2, 7 and 8, the body peripheral surface **28** may have a plurality of circumferentially spaced apart body recesses **30** equal in number to the plurality of support pads **24, 24',** and the median plane **M** may intersect each of the plurality of body recesses **30**.

[0023] In some embodiments of the present invention, each of the plurality of body recesses **30** may open out to at least one of the two opposing end surfaces **26a, 26b.**

[0024] Also, in some embodiments of the present invention, each of the plurality of body recesses **30** may open out to both opposing end surfaces **26a, 26b.**

[0025] It should be appreciated that each body recess **30** may provide the space necessary to removably retain a cutting insert **32** and evacuate metal chips produced during a cutting operation.

[0026] In some embodiments of the present invention, the body peripheral surface **28** may have a plurality of outer peripheral portions **34** circumferentially alternating with the plurality of body recesses **30**.

[0027] As shown in Figs. 4 and 10, each outer peripheral portion **34** may intersect the median plane **M** to define the arc of a first pie-shaped sector **S1** having a first center point **C1** contained in the axis of rotation **R,** and each first pie-shaped sector **S1** may at least partially contain the axial projection of a single support pad **24, 24'.**

[0028] Also, in some embodiments of the present invention, the plurality of first pie-shaped sectors **S1** may be identical to each other.

[0029] Further, in some embodiments of the present invention, each first pie-shaped sector **S1** may subtend a first sector angle β**1,** and the first sector angle β**1** may have a value of less than 15 degrees.

[0030] As shown in Figs. 2 and 8, two annular-shaped planes **P1** are equidistantly offset from opposite sides of the median plane **M** by a first distance **D1,** and each of the plurality of support pads **24, 24'** intersects one of the two annular-shaped planes **P1,** and the cutter body **22** intersects neither of the two annular-shaped planes **P1.**

[0031] In some embodiments of the present invention, not all of the plurality of support pads **24, 24'** intersect the same annular-shaped plane **P1.**

[0032] Also, in some embodiments of the present invention, the plurality of support pads **24, 24'** may be identical to each other, and an equal number of support pads **24, 24'** may intersect each of the two annular-shaped planes **P1.**

[0033] As shown in Figs. 1, 2, 7 and 8, the cutter body **22** is disk-shaped.

[0034] In some embodiments the cutter body **22** may have a radially inner central hub **36** connected to a radially outer annular body portion **23.** The central hub **36** projects from at least one of the two opposing end surfaces **26a, 26b** of the cutter body **22,** and may have a central aperture **38** axially extending therethrough.

[0035] It should be appreciated that the central hub **36** intersects neither of the two annular-shaped planes **P1** by virtue of the two annular-shaped planes **P1** each having an inner diameter greater than an outer diameter of the central hub **36.** Thus, the two annular-shaped planes **P1** can be considered to face only the outer annular body portion **23.**

[0036] As shown in Figs. 1 and 7, the cutter body **22** may have a plurality of pad pockets **40** for mounting and indexing the plurality of support pads **24, 24'.** The support pads **24, 24'** protrude axially outward of the radially outer annular body portion **23.**

[0037] In some embodiments of the present invention, as shown in Figs. 5, 6, 11 and 12, each pad pocket **40** may have a planar seat surface **42** non-parallel to the median plane **M,** each support pad **24, 24'** may have opposing upper and lower surfaces **44, 46** and a pad peripheral surface **48** extending therebetween, and each lower surface **46** may abut its associated seat surface **42** in each index position of the support pad **24, 24'.**

[0038] Also, in some embodiments of the present invention, each seat surface **42** may form an acute first inclination angle α**1** with the median plane **M,** and the first inclination angle α**1** may have a value of less than 20 degrees.

[0039] Further, in some embodiments of the present invention, each seated support pad **24, 24'** may have an axially outermost point No located a second distance **D2** from the median plane **M,** and each support pad **24, 24'** may be indexable in its associated pad pocket **40** to increase or decrease the second distance **D2.**

[0040] Still further, in some embodiments of the present invention, the axially outermost point No of each seated support pad **24, 24'** may be formed on its upper surface **44,** and each upper surface **44** may be convexly shaped.

[0041] It should be appreciated that the abutment of each lower surface **46** against its associated seat surface **42** in each index position of the seated support pad **24, 24'** results in an advantageously stable configuration, which enables accurate and reliable adjustment of the

second distance **D2.**

[0042] It should also be appreciated that the axially outermost point No of each seated support pad **24, 24'** may be formed on a different portion of its upper surface **44** in each index position.

[0043] In some embodiments of the present invention, each support pad **24, 24'** may be indexable about a pocket axis **A1** perpendicular to its associated seat surface **42.**

[0044] As shown in Figs. 5 and 11, each pad peripheral surface **48** may have an upper portion **50** intersecting its associated upper surface **44,** and each upper portion **50** may exhibit N-fold rotational symmetry about a pad axis **A2** which passes through the center of the upper surface **44.**

[0045] In some embodiments of the present invention, each support pad **24, 24'** may have **N** index positions in its associated pad pocket **40**, and the pad axis **A2** may be non-perpendicular to its associated seat surface **42.**

[0046] Also, in some embodiments of the present invention, each pad peripheral surface **48** may have a lower portion **52** intersecting its associated lower surface **46,** and the lower portion **52** may be wedge-shaped in a side view of the support pad **24, 24'.**

[0047] Further, in some embodiments of the present invention, each lower surface **46** may be planar, and each pad axis **A2** may be non-perpendicular to its associated lower surface **46.** In one embodiment, the pad axis **A2** forms an angle of between 88° - 89° with the lower surface **46.**

[0048] As shown in Figs. 5 and 11, each pad axis **A2** may form an acute second inclination angle α**2** with its associated seat surface **42,** and the second inclination angle α**2** may have a value of greater than 80 degrees.

[0049] It should be appreciated that for embodiments of the present invention where the pocket and pad axes **A1**, **A2** are non-coaxial, the upper portion **50** may be eccentrically indexable about the pocket axis **A1**.

[0050] It should also be appreciated that the provision of **N** index positions for each support pad **24, 24'** in its associated pad pocket **40** enables incremental adjustment of the second distance **D2.**

[0051] In some embodiments of the present invention, **N** may be a value of at least three.

[0052] Also, in some embodiments of the present invention, **N** may be a value of at most sixteen.

[0053] Further, in some embodiments of the present invention, N may be an even number, and the second distance **D2** may be set to maximum and minimum values at two rotationally opposite index positions.

[0054] It should be appreciated that for embodiments where N is an even number, the second distance **D2** may have (N-2)/2 increments between its maximum and minimum values. For example, for a total of N = 8 index positions, there may be four distance increments upon indexing (i.e., "rotating") the support pad from an initial 0° position by 45°, 90°, 135° and 180° in either direction. Furthermore, the distance increment from one index position to the next need not be equal. For example, in one embodiment, indexing the support pad from the 0° position to 45°, 90°, 135° and 180° may result in stepwise distance increments of +0.010 mm, +0.0250 mm, +0.040 mm and +0.045 mm, respectively.

[0055] As seen in Figs. 3 and 9, the upper surface **44** may be provided with indexing indicia **45** reflective of a current index position of a support pad **24, 24'.** In one embodiment, the index indicia comprises a notch formed at a particular circumferential location on the upper surface **44.** In another embodiment, the index indicia may take the form of alphanumeric characters or other symbols.

[0056] In some embodiments of the present invention, the second distance **D2** associated with each support pad **24, 24'** may be equal to or greater than the first distance **D1.**

[0057] It should be appreciated that in some embodiments of the present invention, the second distance **D2** may be equal to the first distance **D1** in one index position of the associated support pad **24, 24',** and the second distance **D2** may be greater than the first distance **D1** in N-1 index positions of the associated support pad **24, 24'.**

[0058] In some embodiments of the present invention, each upper portion **50** may have **N** planar facets **54,** and at least three consecutive planar facets **54** about the pad axis **A2** may face an equal number of corresponding planar walls **56** in the associated pad pocket **40.**

[0059] It should be appreciated that the provision of the at least three planar walls **56** in each pad pocket **40** may assist the operator to perform swift and repeatable indexing of the associated support pad **24, 24'** and restrict inadvertent rotation of the support pad **24, 24'** in the pad pocket **40**.

[0060] In some embodiments of the present invention, each support pad **24, 24'** may be removably fastened in its associated pad pocket **40** by means of a fastening screw **58.**

[0061] In a first embodiment of the present invention, as shown in Fig. 5, each support pad **24** may have a protuberance **60** extending away from its lower surface **46,** and the fastening screw **58** may threadingly engage a first threaded bore **62** in a distal surface **64** of the protuberance **60**.

[0062] Also, in the first embodiment of the present invention, the first threaded bore **62** may be coaxial with the pocket axis **A1**, when the support pad 24 is seated therein.

[0063] Further, in the first embodiment of the present invention, the support pad **24** may be manufactured from hardened steel.

[0064] It should be appreciated that the first embodiment of the present invention provides an advantageously compact configuration of the each support pad **24** in combination with its fastening screw **58.**

[0065] In a second embodiment of the present invention, as shown in Fig. 11, each support pad **24'** may not have a protuberance extending away from its lower surface **46,** and the fastening screw **58** may threadingly en-

gage a second threaded bore **66** in the pad pocket **40**, and a screw head **68** of the fastening screw **58** may abut one of the planar facets **54** of the support pad **24'.**

[0066] Also, in the second embodiment of the present invention, the support pads **24'** may be manufactured from cemented carbide.

[0067] It should be appreciated that the support pads **24'** associated with second embodiment of the present invention may be simply and inexpensively manufactured by means of a pressing and sintering process.

[0068] Attention is now drawn to Figs. 13 to 16, showing a cutting tool **70** including the cutter body assembly **20** and a plurality of cutting inserts **32** removably retained in the cutter body **22** and circumferentially spaced about the body peripheral surface **28.**

[0069] In some embodiments of the present invention, the cutter body **22** may be coupled with a tool shank **72** extending along the axis of rotation **R.**

[0070] Also, in some embodiments of the present invention, each cutting insert **32** may be directly mounted in an insert receiving pocket **74** in its respective body recess **30**.

[0071] In other embodiments of the present invention (not shown), each cutting insert may be indirectly mounted in its respective insert receiving pocket by means of a cartridge permitting axial position adjustment of the cutting insert.

[0072] According to the present invention, as shown in Figs. 14 and 15, each of the plurality of support pads **24** is configured to make operative contact with a machined surface **76a, 76b** of a workpiece **78,** and the machined surface **76a, 76b** is perpendicular to the axis of rotation **R.**

[0073] In some embodiments of the present invention, the total number of support pads **24** and the total number of cutting inserts **32** may be equal.

[0074] Also, in some embodiments of the present invention, the upper surface **44** of each support pad **24** may make operative contact with its associated machined surface **76a, 76b,** to stabilize the rotating cutter body **22** as it cuts deeper into the workpiece **78.**

[0075] It should be appreciated that for embodiments of the present invention where the upper surface **44** of each support pad **24** is convexly shaped, low-friction operative contact is made with its associated machined surface **76a, 76b** at a single contact point.

[0076] It should also be appreciated that the single contact point associated with each support pad **24** coincides with its axially outermost point No, which advantageously with respect to extended service life, may be formed on a different portion of its upper surface **44** in each index position.

[0077] In some embodiments of the present invention, an operative cutting edge **80** of each of the plurality of cutting inserts **32** may intersect exactly one of the two annular-shaped planes **P1** and also the median plane **M** at a median intersection point $\mathbf{I_M}$.

[0078] Also, in some embodiments of the present invention, not all of the plurality of operative cutting edges **80** may intersect the same annular-shaped plane **P1**.

[0079] Further, in some embodiments of the present invention, the plurality of cutting inserts **32** may be identical to each other, and an equal number of operative cutting edges **80** may intersect each of the two annular-shaped planes **P1.**

[0080] As shown in Figs. 14 and 15, the rotary cutting tool **70** may be configured to cut a slot **82** in the workpiece **78** having two parallel machined surfaces **76a, 76b,** and the slot **82** may have a slot width **W** equal to or greater than two times the first distance **D1**.

[0081] In some embodiments of the present invention, the median plane **M** may bisect the slot **82.**

[0082] It should be appreciated that cutting inserts **32** having operative cutting edges **80** which intersect exactly one of the two annular-shaped planes **P1** may cut only one of the two parallel machined surfaces **76a, 76b** and a portion of the slot width **W,** and such cutting inserts **32** may be termed 'half-effective'.

[0083] It should also be appreciated that 'half-effective' cutting inserts **32** may cause axial cutting forces $\mathbf{F_A}$ to act on the cutting tool **70** in a direction away from their associated machined surface **76a, 76b.**

[0084] In some embodiments of the present invention, the cutting tool **70** may be set-up to perform a slotting or slitting operation by indexing each support pad **24** so that **D2** = W/2. This ensures that each support pad **24** makes operative contact with its associated machined surface **76a, 76b,** which advantageously restricts axial deflection of the cutting tool **70** caused by 'half-effective' cutting inserts **32** engaging the opposite machined surface **76a, 76b,** thus resulting in a highly accurate slot width **W.** In such case, the support pads **24** collectively have an axial extent corresponding to the slot width **W.**

[0085] It should also be appreciated that indexing of support pads **24** during set-up may be performed in response to worn operative cutting edges **80**, or alternatively, in other embodiments of the present invention (not shown), where cutting inserts have undergone axial position adjustment in the cutting tool.

[0086] In some embodiments of the present invention, two circumferentially adjacent support pads **24** may intersect different annular-shaped planes **P1.**

[0087] Also, in some embodiments of the present invention, the operative cutting edges **80** of two circumferentially adjacent cutting inserts **32** may intersect different annular-shaped planes **P1.**

[0088] As shown in Fig. 18, the median intersection points $\mathbf{I_M}$ of two circumferentially adjacent cutting inserts **32** may define the arc end points of a second pie-shaped sector **S2** having a second center point **C2** contained in the axis of rotation **R,** and each second pie-shaped sector **S2** may contain the axial projection of just a single support pad **24.**

[0089] In some embodiments of the present invention, the plurality of second pie-shaped sectors **S2** may be identical to each other.

[0090] Further, in some embodiments of the present

invention, each second pie-shaped sector **S2** may subtend a second sector angle β**2,** and the second sector angle β**2** may have a value of less than 30 degrees.

[0091] As shown in Figs. 16 and 17, the cutting tool **70** has a direction of rotation $\mathbf{D_R}$ about the axis of rotation **R.**

[0092] In some embodiments of the present invention, where the operative cutting edges **80** of two circumferentially adjacent cutting inserts **32** intersect different annular-shaped planes **P1,** each support pad **24** may be located rotationally rearward of the circumferentially adjacent cutting insert **32** whose operative cutting edge **80** intersects a different annular-shaped plane **P1** to that of the support pad **24.**

[0093] Also, in some embodiments of the present invention, each pocket axis **A1** may intersect the two annular-shaped planes **P1** at first and second intersection points **11, 12.** Each first intersection point **I1** may be located rotationally forward of its associated second intersection point **I2**, and each seat surface **42** may face towards the annular-shaped plane **P1** containing its associated first point **I1.**

[0094] It should be appreciated that locating the first intersection point **I1** rotationally forward of its associated second intersection point **I2** advantageously orientates the support pad **24** with respect to its associated machined surface **76a, 76b** such that the risk of scraping and/or marking is minimized.

[0095] As shown in Fig. 18, the axial projection of each support pad **24** may radially overlap its two circumferentially adjacent cutting inserts **32.** As also seen in this figure, the radially outermost portion of the support pads **24,** as indicated by an arcuate boundary line **Rs,** is radially inward of the operative cutting edges **80** and also radially inward of the outer peripheral portions **34** of the body peripheral surface **28.** Meanwhile, as seen in Fig. 17, the axially outermost point **No** of each support pad **24** is located axially outward of the associated end surface **26a** of the cutter body **22.**

[0096] It should be appreciated that radial overlap of each support pad's axial projection and its two circumferentially adjacent cutting inserts **32** advantageously restricts axial deflection of the cutting tool **70**, thus contributing to a highly accurate slot width **W.**

[0097] In some embodiments of the present invention, as shown in Fig. 18, the axial projection of each support pad **24** may be located closer to the circumferentially adjacent cutting insert **32** whose operative cutting edge **80** intersects a different annular-shaped plane **P1** to that of the support pad **24** than the circumferentially adjacent cutting insert **32** whose operative cutting edge **80** intersects the same annular-shaped plane **P1** as that of the support pad **24.**

[0098] It should also be appreciated that configuring each support pad **24** such that its axial projection is located closer to the circumferentially adjacent cutting insert **32** whose operative cutting edge **80** intersects a different annular-shaped plane **P1** to that of the support pad **24,** advantageously restricts axial deflection of the cutting tool **70**, thus contributing to a highly accurate slot width **W.**

[0099] Although the present invention has been described to a certain degree of particularity, it should be understood that various alterations and modifications could be made without departing from the scope of the invention as hereinafter claimed.

Claims

1. A cutter body assembly (20, 20') comprising:

a disk-shaped cutter body (22) and a plurality of support pads (24, 24') removably retained therein,
the cutter body (22) having an axis of rotation (R), a direction of rotation (D_R) about the axis of rotation (R), two opposing end surfaces (26a, 26b) and a body peripheral surface (28) extending therebetween, and
each of the plurality of support pads (24, 24') protruding from one of the two opposing end surfaces (26a, 26b),
wherein a median plane (M) perpendicular to the axis of rotation (R) intersects the body peripheral surface (28), and two annular-shaped planes (P1) are equidistantly offset from opposite sides of the median plane (M) by a first distance (D1), and
wherein each of the plurality of support pads (24, 24') intersects one of the two annular-shaped planes (P1), and the cutter body (22) intersects neither of the two annular-shaped planes (P1),
wherein the cutter body (22) has a plurality of pad pockets (40) for mounting and indexing the plurality of support pads (24, 24'),
characterized in that
each support pad (24, 24') has an axially outermost point (No) located a second distance (D2) from the median plane (M), and **in that**
each support pad (24, 24') is indexable in its associated pad pocket (40) to increase or decrease the second distance (D2).

2. The cutter body assembly (20, 20') according to claim 1, wherein the body peripheral surface (28) has a plurality of circumferentially spaced apart body recesses (30) equal in number to the plurality of support pads (24, 24'), and
wherein the median plane (M) intersects each of the plurality of body recesses (30).

3. The cutter body assembly (20, 20') according to claim 1 or 2, wherein the second distance (D2) is equal to or greater than the first distance (D1).

4. A support pad (24, 24') removably retainable in a disk-shaped cutter body (22), comprising:

opposing upper and lower surfaces (44, 46) and a pad peripheral surface (48) extending therebetween,
the lower surface (46) being planar and configured to abut an associated seat surface (42) of a pad pocket (40) in the cutter body (22), and
the pad peripheral surface (48) having an upper portion (50) intersecting the upper surface (44),
characterized in that
the upper portion (50) exhibits N-fold rotational symmetry about a pad axis (A2), and **in that**
the pad axis (A2) is non-perpendicular to the lower surface (46).

5. The support pad (24, 24') according to claim 4, wherein N is a value of at least three.

6. The support pad (24, 24') according to claim 4 or 5, wherein the upper surface (44) is convexly shaped, and configured to make operative contact with a machined surface (76a, 76b) of a workpiece (78).

7. A cutting tool (70) comprising:

a cutter body assembly (20) including a disk-shaped cutter body (22) and a plurality of support pads (24) removably retained therein,
the cutter body (22) having an axis of rotation (R), a direction of rotation (D_R) about the axis of rotation (R), two opposing end surfaces (26a, 26b) and a body peripheral surface (28) extending therebetween, and
a plurality of cutting inserts (32) removably retained in the cutter body (22) and circumferentially spaced about the body peripheral surface (28),
wherein:

a median plane (M) perpendicular to the axis of rotation (R) intersects the body peripheral surface (28), and two annular-shaped planes (P1) are equidistantly offset from opposite sides of the median plane (M) by a first distance (D1),
the cutter body (22) intersects neither of the two annular-shaped planes (P1),
each of the plurality of support pads (24) protrudes from one of the two opposing end surfaces (26a, 26b),
each of the plurality of support pads (24) intersects one of the two annular-shaped planes (P 1) and is configured to make operative contact with a machined surface (76a, 76b) of a workpiece (78), and
the machined surface (76a, 76b) is perpendicular to the axis of rotation (R),
characterized in that
not all of the plurality of support pads (24) intersect the same annular-shaped plane (P 1).

8. The cutting tool (70) according to claim 7, wherein the total number of support pads (24) and the total number of cutting inserts (32) are equal.

9. The cutting tool (70) according to claim 7 or 8, wherein the plurality of support pads (24) are identical to each other, and
wherein an equal number of support pads (24, 24') intersect each of the two annular-shaped planes (P1).

10. The cutting tool (70) according to any one of claims 7 to 9, wherein each of the plurality of support pads (24) protrudes from only one of the two opposing end surfaces (26a, 26b).

11. The cutting tool (70) according to any one of claims 7 to 10, wherein an operative cutting edge (80) of each of the plurality of cutting inserts (32) intersects exactly one of the two annular-shaped planes (P1) and also the median plane (M) at a median intersection point (I_M).

12. The cutting tool (70) according to claim 11, wherein not all of the plurality of operative cutting edges (80) intersect the same annular-shaped plane (P1).

13. The cutting tool (70) according to any one of claims 7 to 12, wherein the rotary cutting tool (70) is configured to cut a slot (82) in the workpiece (78) having two parallel machined surfaces (76a, 76b), and
wherein the slot (82) has a slot width (W) equal to or greater than two times the first distance (D1).

14. The cutting tool (70) according to any one of claims 7 to 13, wherein the cutter body (22) has a plurality of pad pockets (40) for mounting and indexing the plurality of support pads (24), and each support pad (24) has an axially outermost point (No) located a second distance (D2) from the median plane (M), and
wherein each support pad (24) is indexable in its associated pad pocket (40) to increase or decrease the second distance (D2).

15. The cutting tool (70) according to claim 14, wherein the second distance (D2) is equal to or greater than the first distance (D1).

Patentansprüche

1. Schneidkörperanordnung (20, 20'), die aufweist:

einen scheibenförmigen Schneidkörper (22)

und mehrere Stützpolster (24, 24'), die abnehmbar darin gehalten werden,
wobei der Schneidkörper (22) eine Drehachse (R), eine Drehrichtung (D_R) um die Drehachse (R), zwei gegenüberliegende Endflächen (26a, 26b) und eine sich dazwischen erstreckende Körperumfangsfläche (28) aufweist, und
wobei jedes der mehreren Stützpolster (24, 24') von einer der beiden gegenüberliegenden Endflächen (26a, 26b) vorsteht,
wobei eine Mittelebene (M) senkrecht zur Drehachse (R) die Körperumfangsfläche (28) schneidet und zwei ringförmige Ebenen (P1) von gegenüberliegenden Seiten der Mittelebene (M) um einen ersten Abstand (D1) äquidistant versetzt sind, und
wobei jedes der mehreren Stützpolster (24, 24') eine der beiden ringförmigen Ebenen (P 1) schneidet, und der Schneidkörper (22) keine der beiden ringförmigen Ebenen (P1) schneidet,
wobei der Schneidkörper (22) mehrere Polstertaschen (40) zum Montieren und Wenden der mehreren Stützpolster (24, 24') aufweist,
dadurch gekennzeichnet, dass
jedes Stützpolster (24, 24') einen axial äußersten Punkt (No) aufweist, der sich in einem zweiten Abstand (D2) von der Mittelebene (M) befindet, und, dass
jedes Stützpolster (24, 24') in seiner zugehörigen Polstertasche (40) wendbar ist, um den zweiten Abstand (D2) zu vergrößern oder zu verringern.

2. Schneidkörperanordnung (20, 20') nach Anspruch 1, wobei die Körperumfangsfläche (28) mehrere in Umfangsrichtung beabstandete Körperaussparungen (30) aufweist, deren Anzahl gleich der mehreren Stützpolster (24, 24') ist, und
wobei die Mittelebene (M) jede der mehreren Körperaussparungen (30) schneidet.

3. Schneidkörperanordnung (20, 20') nach Anspruch 1 oder 2, wobei der zweite Abstand (D2) gleich oder größer ist als der erste Abstand (D1).

4. Stützpolster (24, 24'), das abnehmbar in einem scheibenförmigen Schneidkörper (22) haltbar ist, das aufweist:

einander gegenüberliegende obere und untere Flächen (44, 46) und eine sich dazwischen erstreckende Polsterumfangsfläche (48),
wobei die untere Fläche (46) eben ist und so konfiguriert ist, dass sie an einer zugehörigen Sitzfläche (42) einer Polstertasche (40) im Schneidkörper (22) anliegt, und
die Polsterumfangsfläche (48) einen oberen Abschnitt (50) aufweist, der die obere Fläche (44) schneidet,
dadurch gekennzeichnet, dass
der obere Abschnitt (50) eine N-fache Rotationssymmetrie um eine Polsterachse (A2) aufweist, und dass
die Polsterachse (A2) nicht senkrecht zur unteren Fläche (46) ist.

5. Stützpolster (24, 24') nach Anspruch 4, wobei N ein Wert von mindestens drei ist.

6. Stützpolster (24, 24') nach Anspruch 4 oder 5, wobei die obere Fläche (44) konvex geformt und konfiguriert ist, mit einer bearbeiteten Oberfläche (76a, 76b) eines Werkstücks (78) wirksamen Kontakt aufzunehmen.

7. Schneidwerkzeug (70), das aufweist:

eine Schneidkörperanordnung (20) mit einem scheibenförmigen Schneidkörper (22) und mehreren Stützpolstern (24), die abnehmbar darin gehalten werden,
wobei der Schneidkörper (22) eine Drehachse (R), eine Drehrichtung (D_R) um die Drehachse (R), zwei gegenüberliegende Endflächen (26a, 26b) und eine sich dazwischen erstreckende Körperumfangsfläche (28) aufweist, und
mehrere Schneideinsätze (32), die abnehmbar im Schneidkörper (22) gehalten werden und in Umfangsrichtung um die Körperumfangsfläche (28) beabstandet sind,
wobei:

eine Mittelebene (M) senkrecht zur Drehachse (R) die Körperumfangsfläche (28) schneidet und zwei ringförmige Ebenen (P1) von gegenüberliegenden Seiten der Mittelebene (M) um einen ersten Abstand (D1) äquidistant versetzt sind,
der Schneidkörper (22) keine der beiden ringförmigen Ebenen (P1) schneidet,
jedes der mehreren Stützpolster (24) von einer der beiden gegenüberliegenden Endflächen (26a, 26b) vorsteht,
jedes der mehreren Stützpolster (24) eine der beiden ringförmigen Ebenen (P1) schneidet und konfiguriert ist, mit einer bearbeiteten Oberfläche (76a, 76b) eines Werkstücks (78) wirksamen Kontakt aufzunehmen, und
die bearbeitete Fläche (76a, 76b) senkrecht zur Drehachse (R) ist, **dadurch gekennzeichnet, dass**
nicht alle der mehreren Stützpolster (24) dieselbe ringförmige Ebene (P1) schneiden.

8. Schneidwerkzeug (70) nach Anspruch 7, wobei die Gesamtzahl der Stützpolster (24) und die Gesamtzahl der Schneideinsätze (32) gleich sind.

9. Schneidwerkzeug (70) nach Anspruch 7 oder 8, wobei die mehreren Stützpolster (24) zueinander identisch sind, und
wobei eine gleiche Anzahl Stützpolster (24, 24') jede der beiden ringförmigen Ebenen (P1) schneidet.

10. Schneidwerkzeug (70) nach einem der Ansprüche 7 bis 9, wobei jedes der mehreren Stützpolster (24) nur von einer der beiden gegenüberliegenden Endflächen (26a, 26b) vorsteht.

11. Schneidwerkzeug (70) nach einem der Ansprüche 7 bis 10, wobei eine wirksame Schneidkante (80) von jedem der mehreren Schneideinsätze (32) genau eine der beiden ringförmigen Ebenen (P1) und auch die Mittelebene (M) in einem mittleren Schnittpunkt (I_M) schneidet.

12. Schneidwerkzeug (70) nach Anspruch 11, wobei nicht alle der mehreren wirksamen Schneidkanten (80) dieselbe ringförmige Ebene (P1) schneiden.

13. Schneidwerkzeug (70) nach einem der Ansprüche 7 bis 12, wobei das Rotationsschneidwerkzeug (70) konfiguriert ist, einen Schlitz (82) in das Werkstück (78) mit zwei parallelen bearbeiteten Oberflächen (76a, 76b) zu schneiden, und
wobei der Schlitz (82) eine Schlitzbreite (W) aufweist, die gleich oder größer ist als das Zweifache des ersten Abstands (D1).

14. Schneidwerkzeug (70) nach einem der Ansprüche 7 bis 13, wobei der Schneidkörper (22) mehrere Polstertaschen (40) zum Montieren und Wenden der mehreren Stützpolster (24) aufweist und jedes Stützpolster (24) einen axial äußersten Punkt (No) aufweist, der sich in einem zweiten Abstand (D2) von der Mittelebene (M) befindet, und
wobei jedes Stützpolster (24) in seiner zugehörigen Polstertasche (40) wendbar ist, um den zweiten Abstand (D2) zu vergrößern oder zu verringern.

15. Schneidwerkzeug (70) nach Anspruch 14, wobei der zweite Abstand (D2) gleich oder größer ist als der erste Abstand (D1).

Revendications

1. Ensemble de corps de coupe (20, 20'), comprenant :

un corps de coupe en forme de disque (22) et une pluralité de patins de support (24, 24') retenus de manière amovible dans le corps de coupe,
le corps de coupe (22) ayant un axe de rotation (R), un sens de rotation (D_R) autour de l'axe de rotation (R), deux surfaces d'extrémité opposées (26a, 26b) et une surface périphérique (28) du corps s'étendant entre elles, et
chaque patin de la pluralité de patins de support (24, 24') faisant saillie sur l'une des deux surfaces d'extrémité opposées (26a, 26b),
où un plan médian (M) perpendiculaire à l'axe de rotation (R) croise la surface périphérique (28) du corps, et deux plans de forme annulaire (P1) sont décalés en équidistance d'une première distance (D1) des côtés opposés du plan médian (M), et
où chaque patin de la pluralité de patins de support (24, 24') croise l'un des deux plans de forme annulaire (P1), et le corps de coupe (22) ne croise aucun des deux plans de forme annulaire (P1),
où le corps de coupe (22) comporte une pluralité de poches de patin (40) pour le montage et l'indexation de la pluralité de patins de support (24, 24'),
caractérisé en ce que
chaque patin de support (24, 24') a un point axialement extérieur (NO) situé à une deuxième distance (D2) du plan médian (M), et **en ce que**
chaque patin de support (24, 24') est indexable dans sa poche de patin (40) associée pour augmenter ou diminuer la deuxième distance (D2).

2. Ensemble de corps de coupe (20, 20') selon la revendication 1, où la surface périphérique (28) du corps présente une pluralité d'évidements (30) de corps espacés circonférentiellement, en nombre égal à celui de la pluralité de patins de support (24, 24'), et
où le plan médian (M) croise chaque évidement de la pluralité d'évidements (30) de corps.

3. Ensemble de corps de coupe (20, 20') selon la revendication 1 ou la revendication 2, où la deuxième distance (D2) est égale ou supérieure à la première distance (D1).

4. Patin de support (24, 24') pouvant être retenu de manière amovible dans un corps de coupe en forme de disque (22), comprenant :

une surface supérieure et une surface inférieure opposées (44, 46), et une surface périphérique (48) s'étendant entre celles-ci,
la surface inférieure (46) étant plane et prévue pour venir en butée contre une surface d'assise (42) associée d'une poche de patin (40) dans le corps de coupe (22), et
la surface périphérique (48) du patin ayant une

partie supérieure (50) croisant la surface supérieure (44),
caractérisé en ce que
la partie supérieure (50) présente une symétrie de rotation à N plis autour d'un axe de patin (A2), et **en ce que**
l'axe de patin (A2) n'est pas perpendiculaire à la surface inférieure (46).

5. Patin de support (24, 24') selon la revendication 4, où N est une valeur égale ou supérieure à trois.

6. Patin de support (24, 24') selon la revendication 4 ou la revendication 5, où la surface supérieure (44) est de forme convexe, et est prévue pour venir en contact fonctionnel avec une surface usinée (76a, 76b) d'une pièce (78).

7. Outil de coupe (70), comprenant :

un ensemble de corps de coupe (20) comprenant un corps de coupe en forme de disque (22) et une pluralité de patins de support (24) retenus de manière amovible dans celui-ci, le corps de coupe (22) ayant un axe de rotation (R), un sens de rotation (D_R) autour de l'axe de rotation (R), deux surfaces d'extrémité opposées (26a, 26b) et une surface périphérique (28) du corps s'étendant entre elles, et
une pluralité de plaquettes de coupe (32) retenues de manière amovible dans le corps de coupe (22) et espacées circonférentiellement autour de la surface périphérique (28) du corps, où :

un plan médian (M) perpendiculaire à l'axe de rotation (R) croise la surface périphérique (28) du corps, et deux plans de forme annulaire (P1) sont décalés en équidistance d'une première distance (D1) des côtés opposés du plan médian (M),
le corps de coupe (22) ne croise aucun des deux plans de forme annulaire (P1),
chaque patin de la pluralité de patins de support (24) fait saillie sur l'une des deux surfaces d'extrémité opposées (26a, 26b),
chaque patin de la pluralité de patins de support (24) croise l'un des deux plans de forme annulaire (P1) et est prévu pour venir en contact fonctionnel avec une surface usinée (76a, 76b) d'une pièce (78), et
la surface usinée (76a, 76b) est perpendiculaire à l'axe de rotation (R),
caractérisé en ce que
les patins de la pluralité de patins de support (24) ne croisent pas tous le même plan de forme annulaire (P1).

8. Outil de coupe (70) selon la revendication 7, où le nombre total de patins de support (24) est identique au nombre total de plaquettes de coupe (32).

9. Outil de coupe (70) selon la revendication 7 ou la revendication 8, où les patins de la pluralité de patins de support (24) sont identiques entre eux, et
où un nombre égal de patins de support (24, 24') croise chacun des deux plans de forme annulaire (P1).

10. Outil de coupe (70) selon l'une des revendications 7 à 9, où chaque patin de la pluralité de patins de support (24) fait saillie sur une seule des deux surfaces d'extrémité opposées (26a, 26b).

11. Outil de coupe (70) selon l'une des revendications 7 à 10, où une arête de coupe fonctionnelle (80) de chaque plaquette de la pluralité de plaquettes de coupe (32) croise précisément l'un des deux plans de forme annulaire (P1) ainsi que le plan médian (M) en un point d'intersection médian (IM).

12. Outil de coupe (70) selon la revendication 11, où toutes les arêtes de la pluralité d'arêtes de coupe fonctionnelles (80) ne croisent pas le même plan de forme annulaire (P1).

13. Outil de coupe (70) selon l'une des revendications 7 à 12, où l'outil de coupe rotatif (70) est prévu pour découper une fente (82) dans la pièce (78) avec deux surfaces usinées parallèles (76a, 76b), et
où la fente (82) a une largeur (W) égale ou supérieure à deux fois la première distance (D 1).

14. Outil de coupe (70) selon l'une des revendications 7 à 13, où le corps de coupe (22) comporte une pluralité de poches de patin (40) pour monter et indexer la pluralité de patins de support (24), et chaque patin de support (24) a un point axialement extérieur (NO) situé à une deuxième distance (D2) du plan médian (M), et où
chaque patin de support (24) est indexable dans sa poche de patin (40) associée pour augmenter ou diminuer la deuxième distance (D2).

15. Outil de coupe (70) selon la revendication 14, où la deuxième distance (D2) est égale ou supérieure à la première distance (D1).

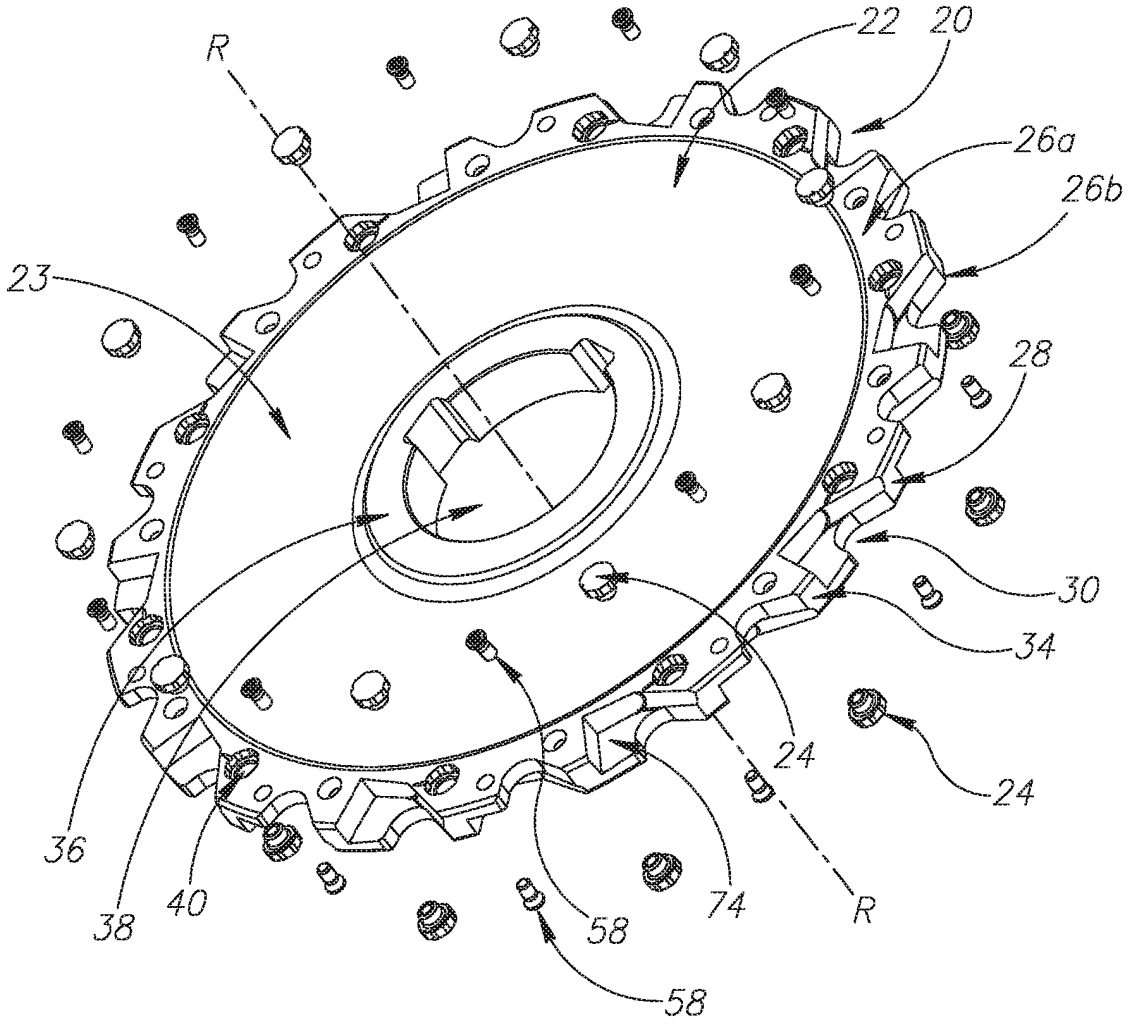
R
22
20
26a
26b
23
28
30
34
24
24
36
38
40
58
74
R
58

FIG.1

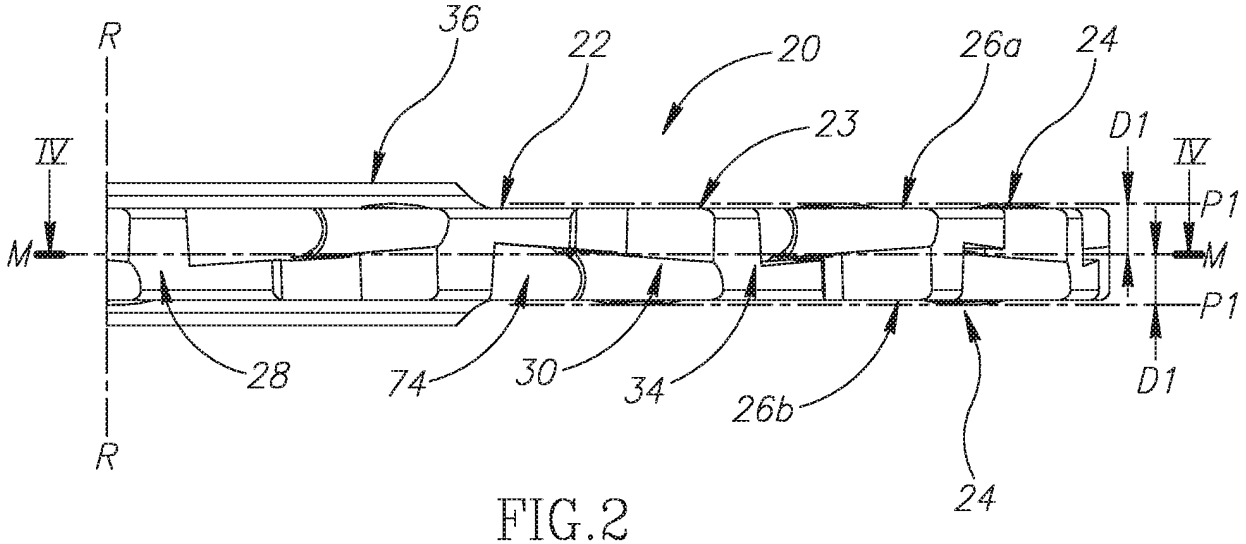
R
36
22
20
26a
24
23
D1
IV
IV
P1
M
M
P1
28
74
30
34
26b
D1
R
24

FIG.2

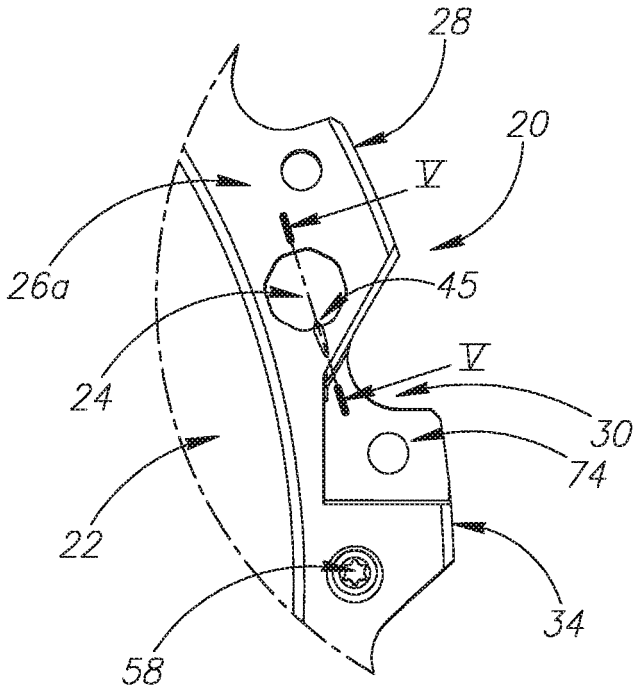
28
20
V
26a
45
24
V
30
74
22
34
58

FIG.3

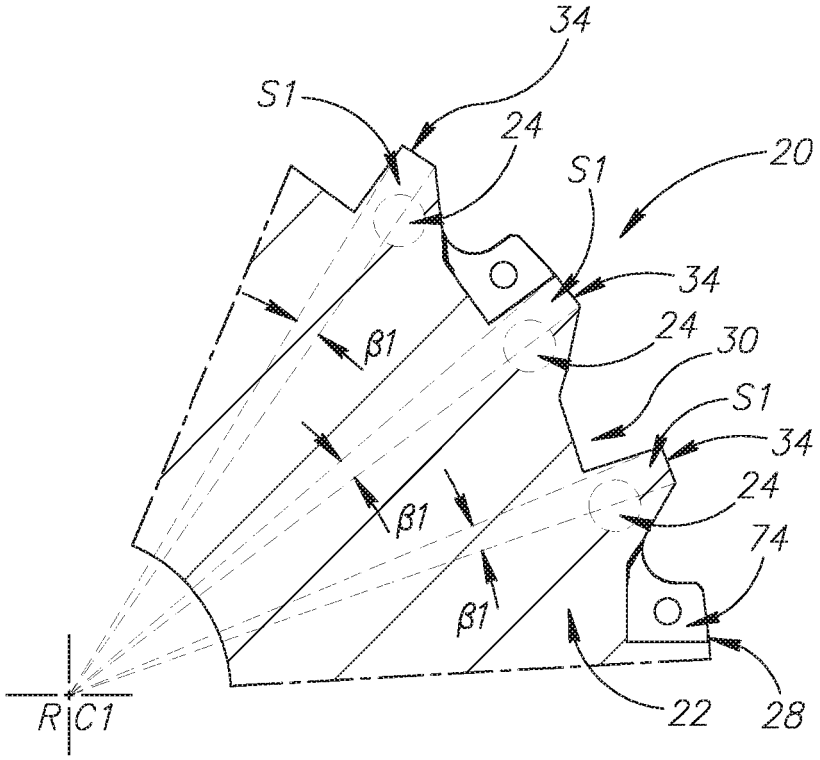
34
S1
24
S1
20
34
β1
24
30
S1
34
β1
24
74
β1
R
C1
22
28

FIG.4

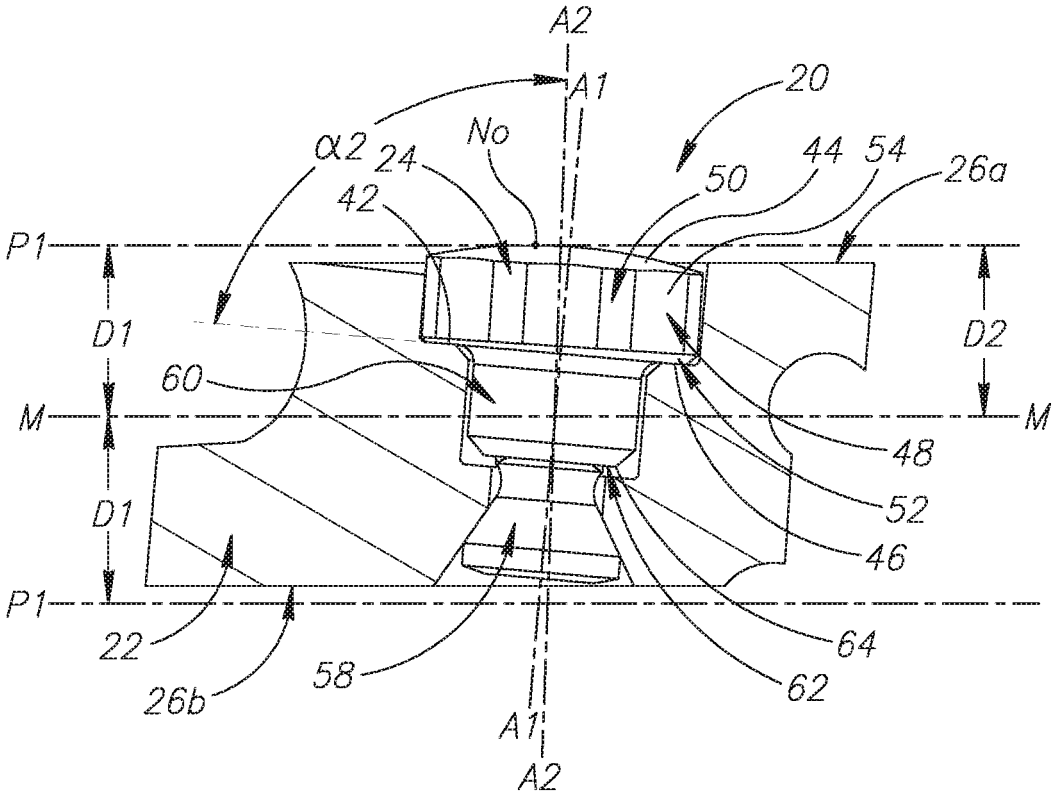
A2
A1
20
α2
24
No
44
54
26a
50
42
P1
D1
D2
60
M
M
48
D1
52
46
P1
22
64
26b
58
62
A1
A2

FIG.5

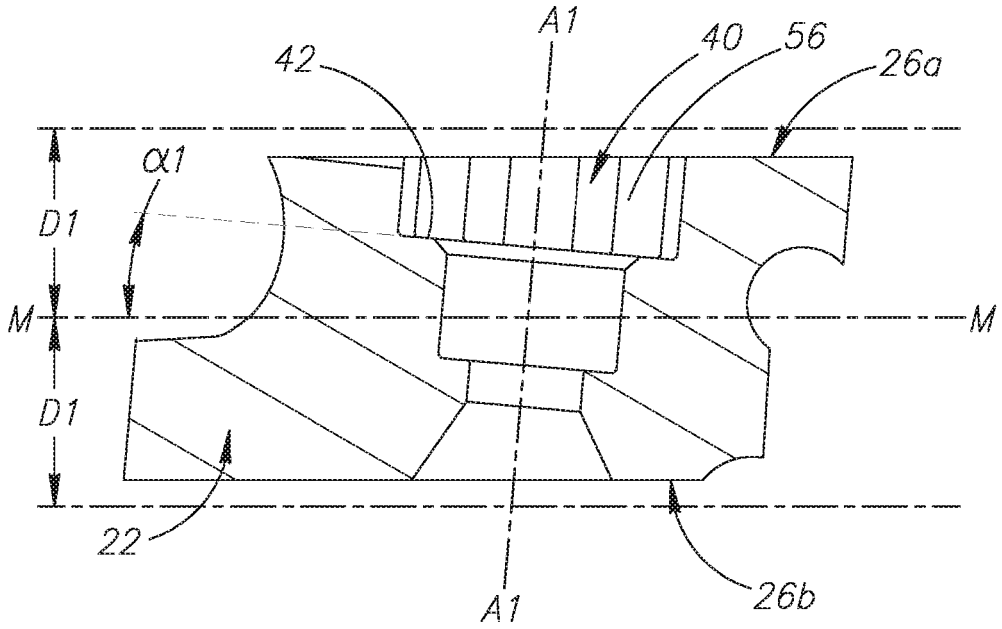
A1
42
40
56
26a
α1
D1
M
M
D1
22
26b
A1

FIG.6

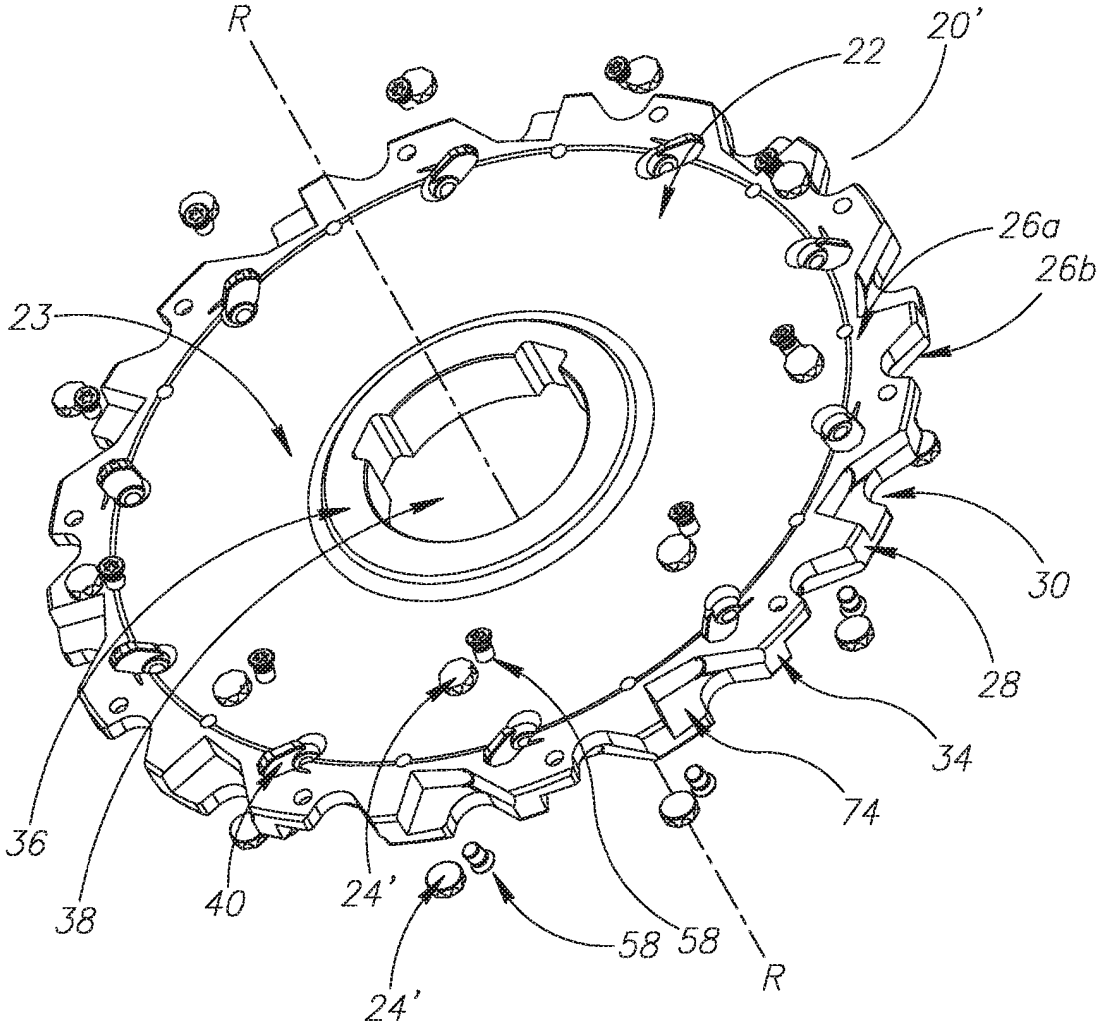
R
20'
22
26a
26b
23
30
28
34
74
36
38
40
24'
58
58
R
24'

FIG.7

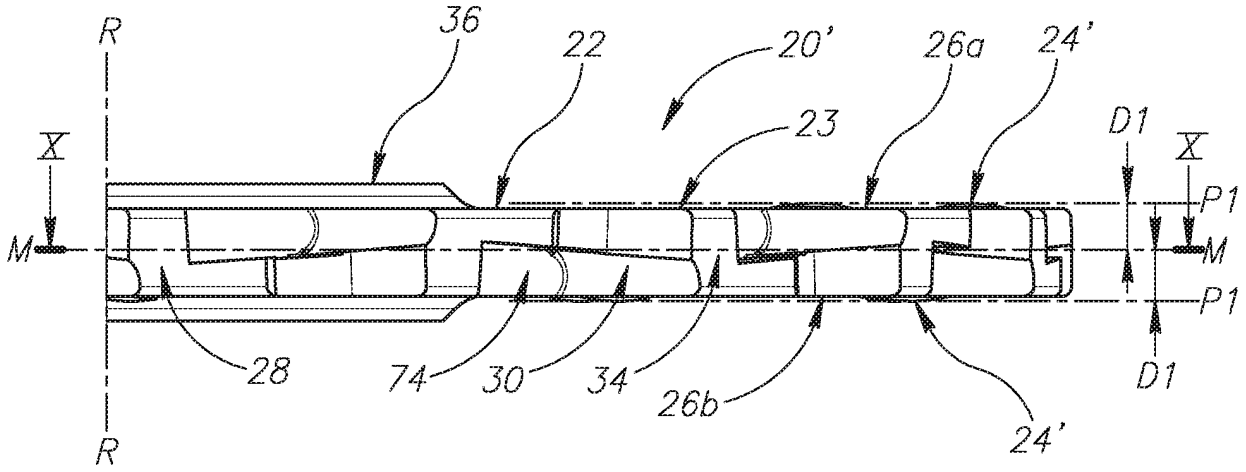
R
36
22
20'
26a
24'
23
D1
X
X
P1
M
M
P1
D1
28
74
30
34
26b
24'
R

FIG.8

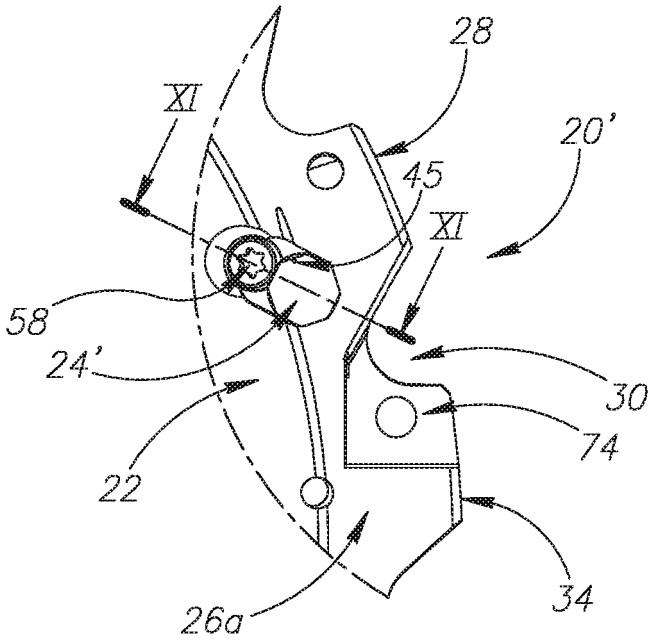
28
XI
20'
45
XI
58
24'
30
74
22
34
26a

FIG.9

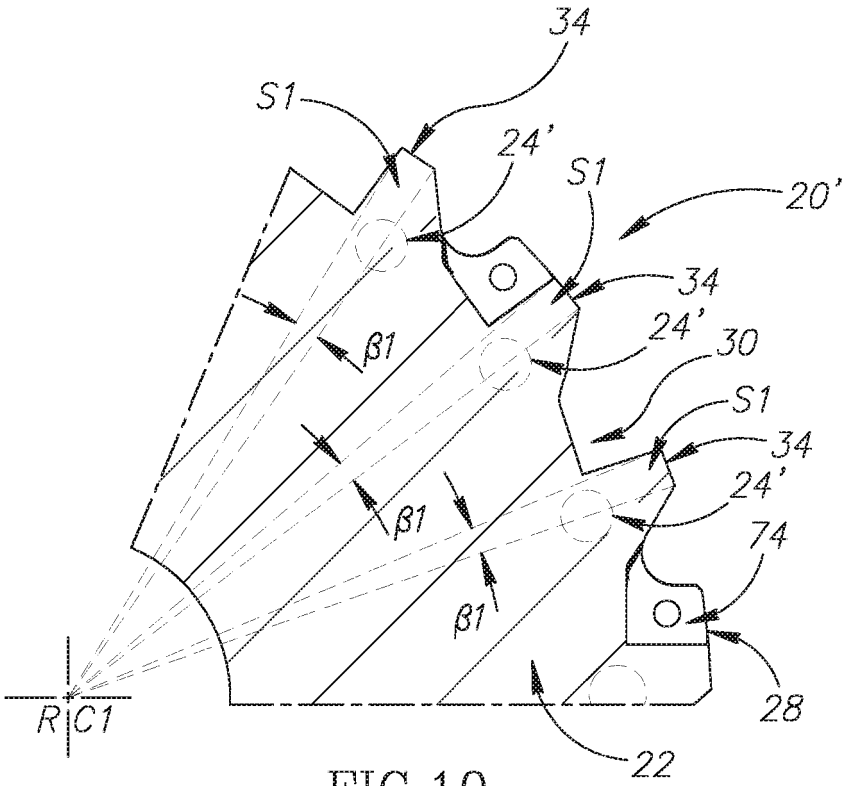
34
S1
24'
S1
20'
34
24'
30
β1
S1
34
24'
β1
74
β1
28
R
C1
22

FIG.10

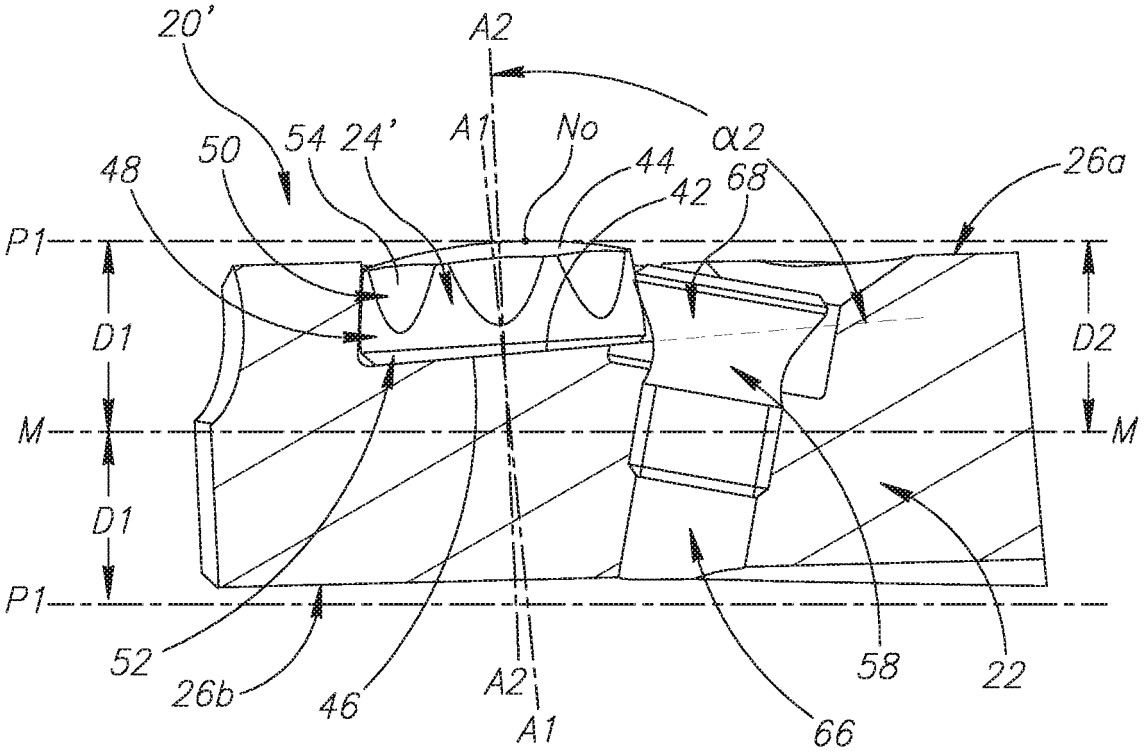
20'
A2
54
24'
A1
No
α2
50
44
42
68
26a
48
P1
D1
D2
M
D1
M
P1
52
26b
46
A2
A1
58
22
66

FIG.11

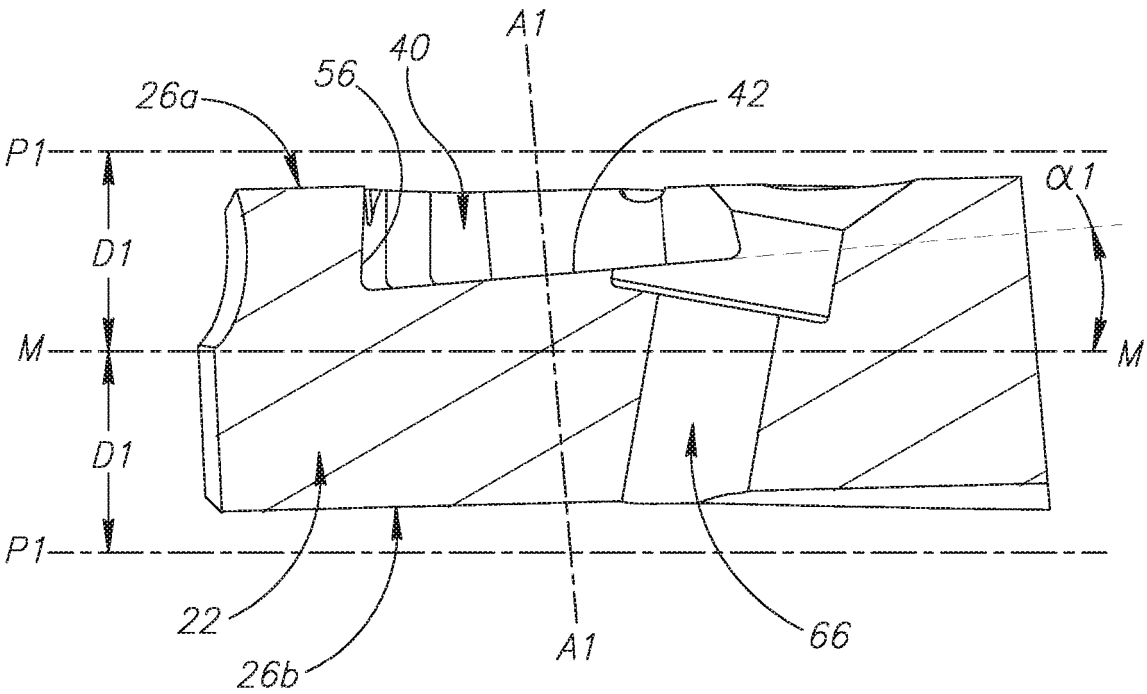
A1
40
56
26a
42
P1
α1
D1
M
D1
M
P1
22
26b
A1
66

FIG.12

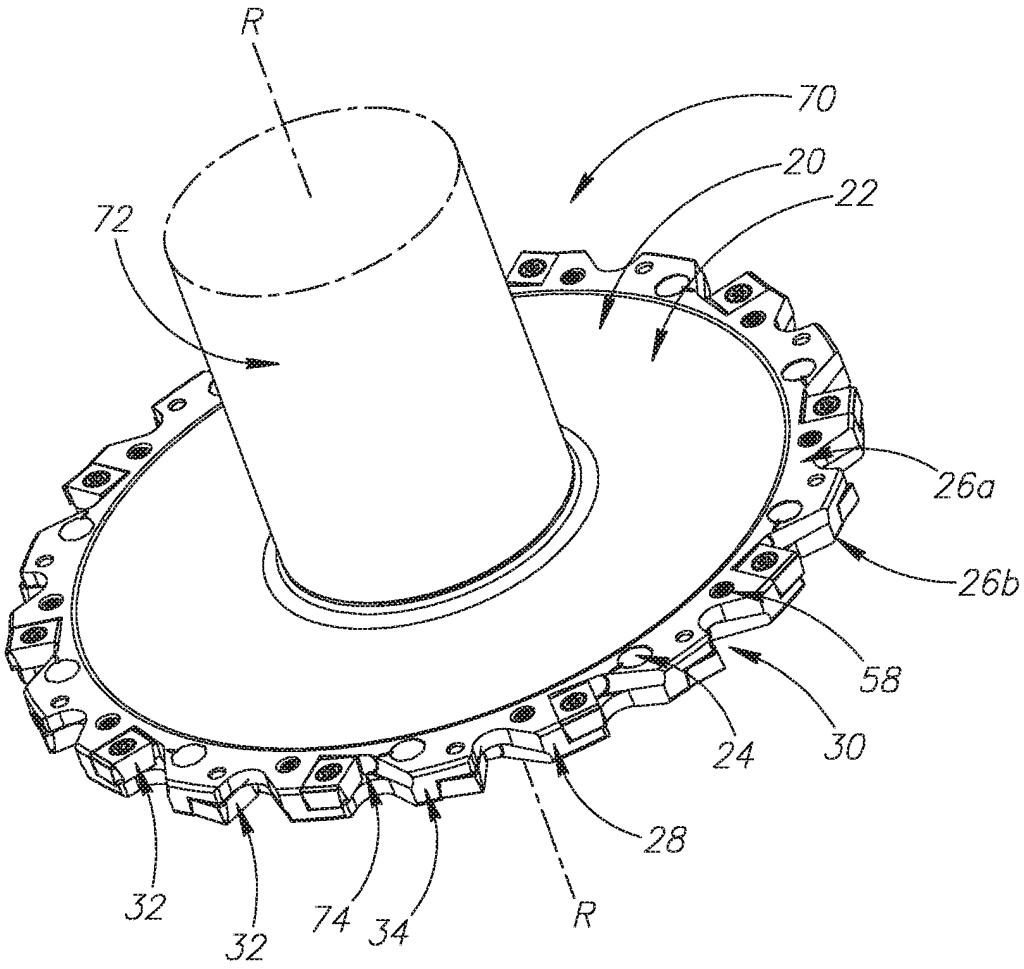
R
70
20
22
72
26a
26b
58
30
24
28
32
32
74
34
R

FIG.13

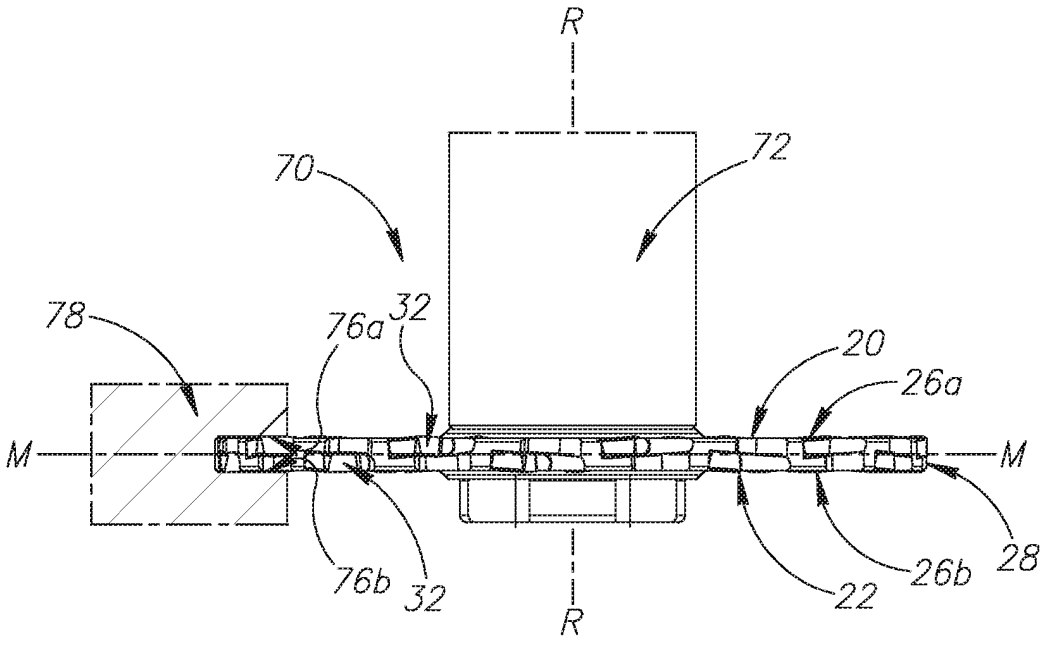
R
70
72
78
76a
32
20
26a
M
M
76b
32
R
22
26b
28

FIG.14

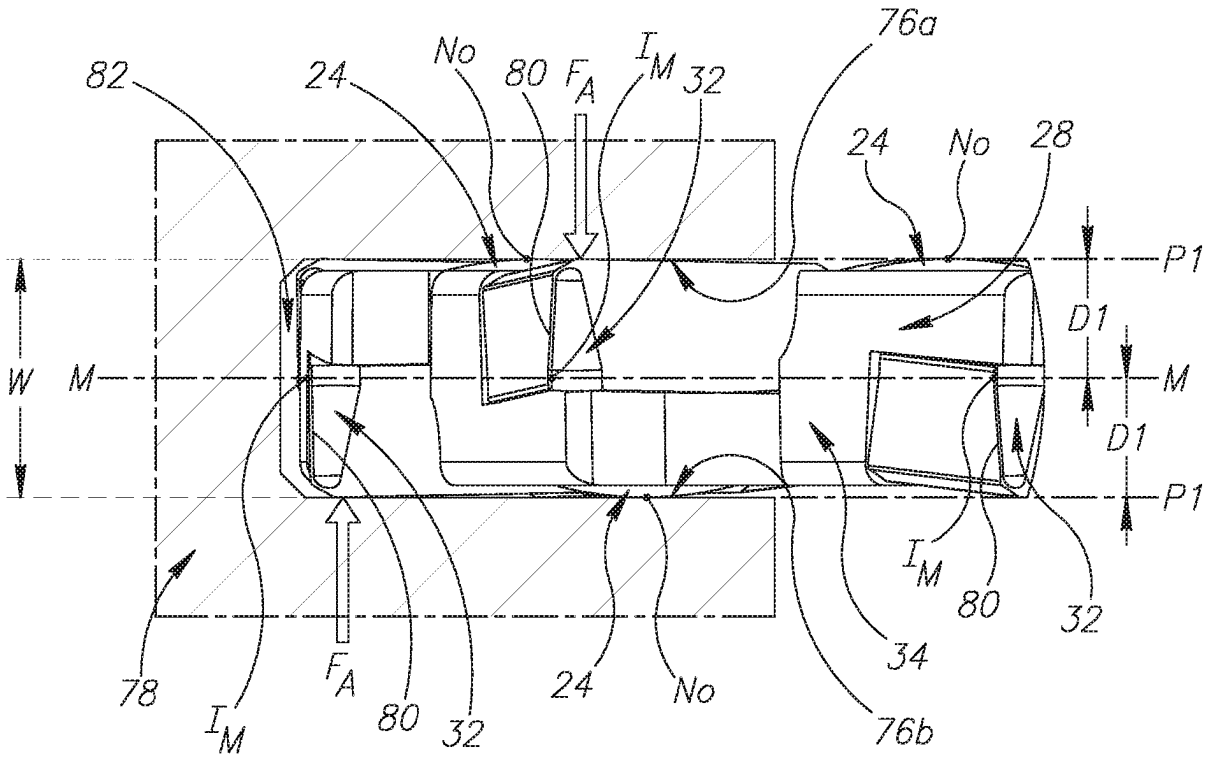
82
24
No
80
F_A
I_M
32
76a
24
No
28
P1
D1
M
W
M
D1
P1
78
I_M
F_A
80
32
24
No
34
76b
I_M
80
32

FIG.15

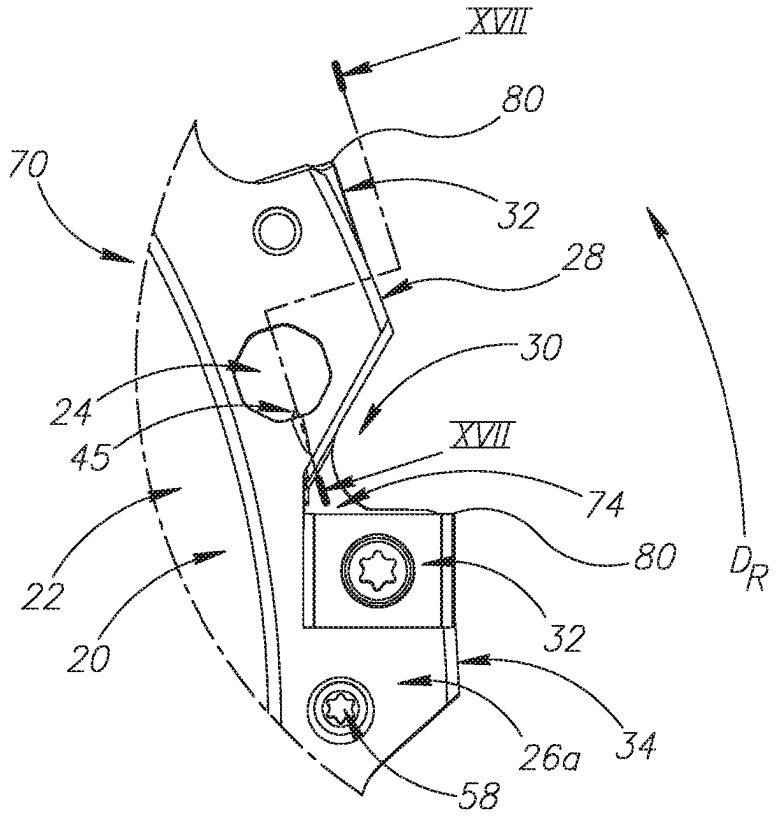
XVII
80
70
32
28
30
24
45
XVII
74
80
D_R
22
20
32
26a
34
58

FIG.16

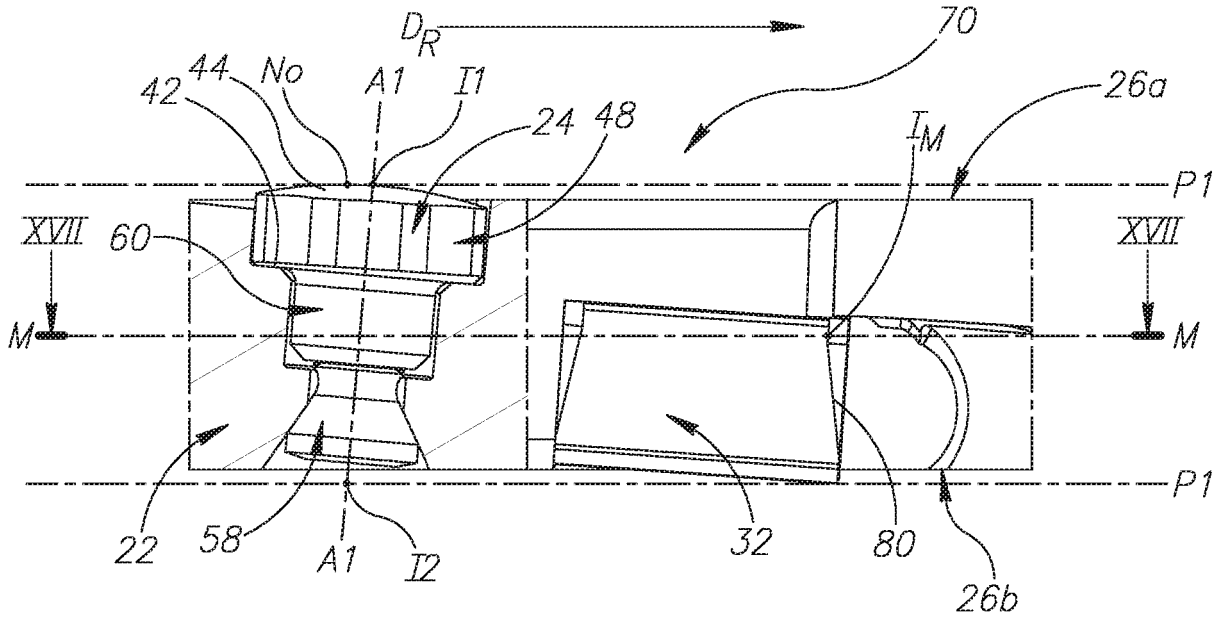
D_R
70
42
44
No
A1
I1
24
48
I_M
26a
P1
XVII
60
XVII
M
M
P1
22
58
A1
I2
32
80
26b

FIG.17

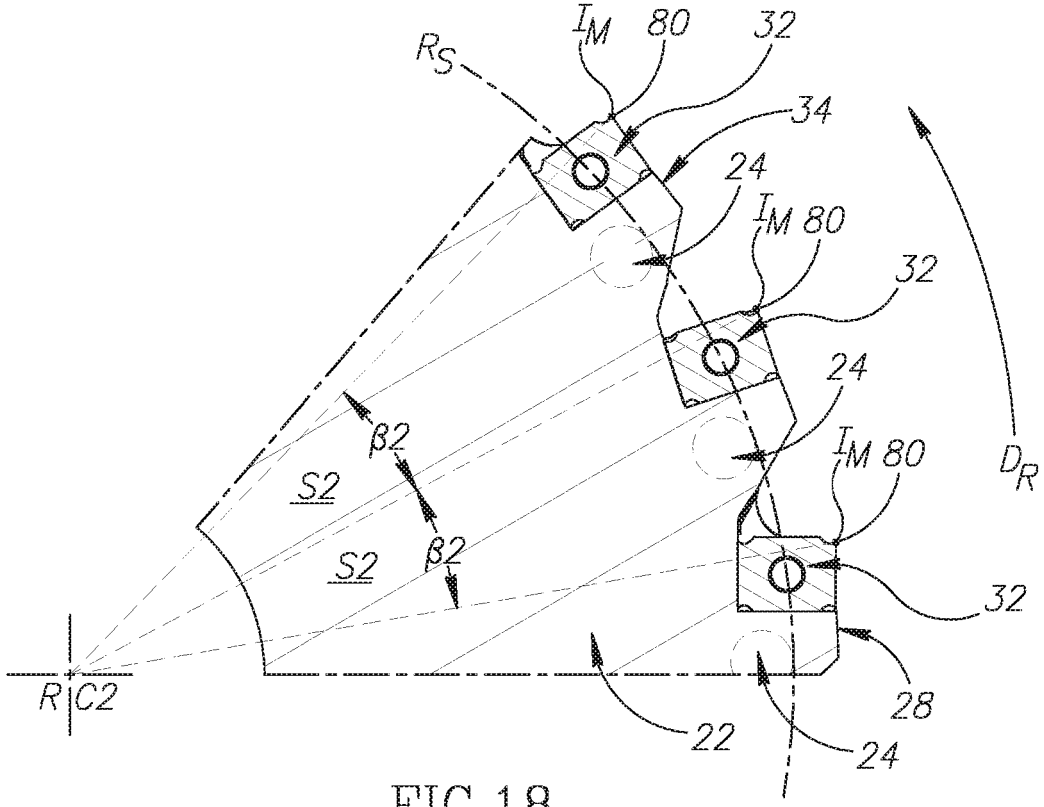
I_M
80
32
R_S
34
24
I_M 80
32
24
I_M 80
D_R
β2
S2
S2
β2
32
R
C2
28
22
24

FIG.18

REFERENCES CITED IN THE DESCRIPTION

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